US006700043B2

(12) **United States Patent**
Hirayama

(10) **Patent No.: US 6,700,043 B2**
(45) **Date of Patent: Mar. 2, 2004**

(54) **ELECTRIC GUITAR WITH TREMOLO UNIT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/171,445**

(22) Filed: **Jun. 13, 2002**

(65) **Prior Publication Data**

US 2003/0066408 A1 Apr. 10, 2003

(30) **Foreign Application Priority Data**

Oct. 9, 2001 (JP) 2001-311521

(51) **Int. Cl.**[7] **G01D 3/06**
(52) **U.S. Cl.** ..... **84/314 N**; 84/314 R; 84/293; 84/318
(58) **Field of Search** ..... 84/314 N, 314 R, 84/293, 318

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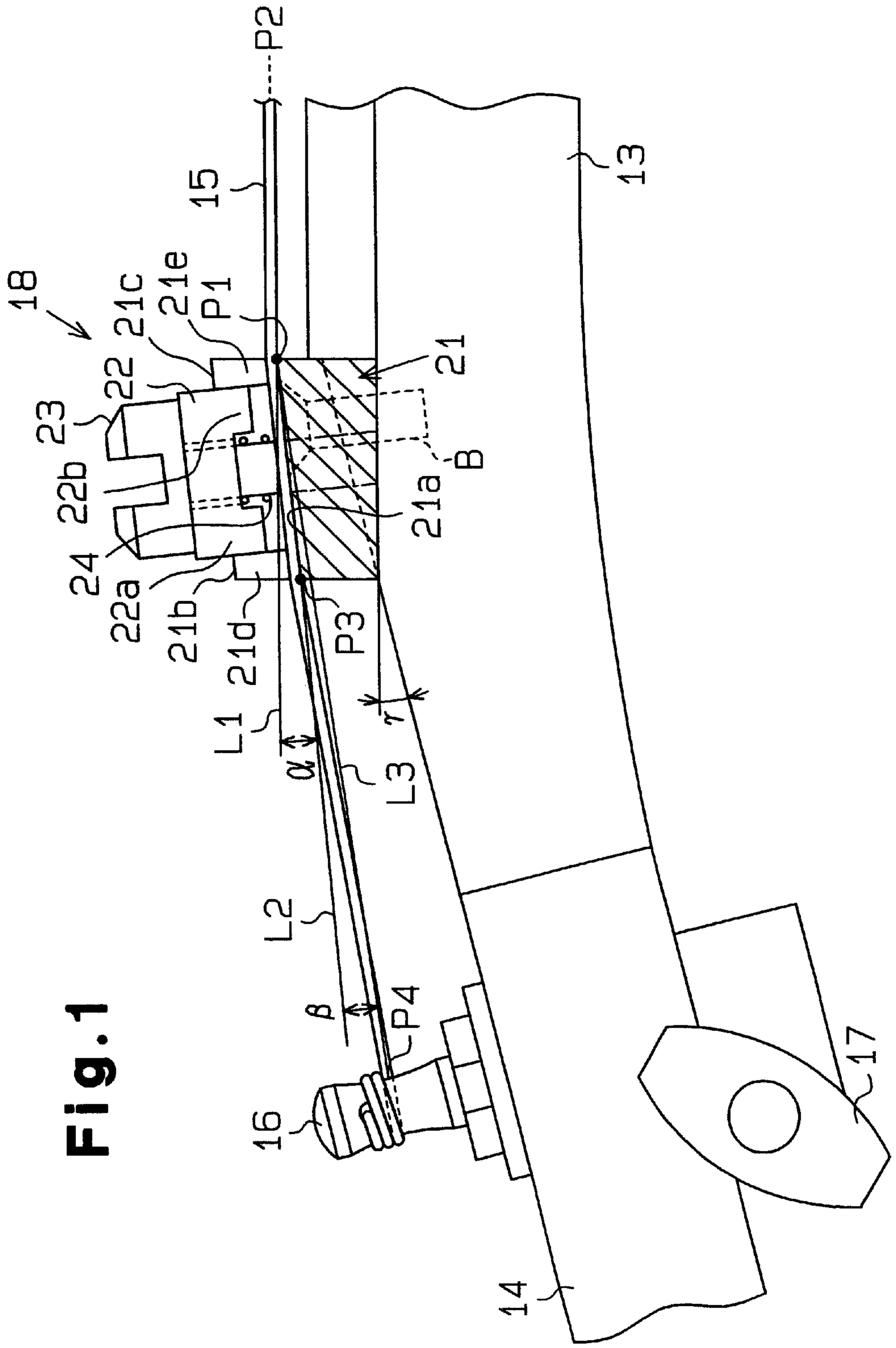
(57) **ABSTRACT**

An electric guitar with a tremolo unit that makes it easy to tune strings and install the strings. The electric guitar includes a lock device that prevents the strings from being shifted to offset positions. The lock device has a nut, which has an inclined support surface, and a clamp pad. The clamp pad clamps the strings with respect to the support surface. A front edge of the nut is located upward from a line, which extends along a contact point between pegs and the strings and a rear edge of the nut. Since the strings are bent by the nut at the front and rear edges, the strings are stopped from being separated from the support surface.

11 Claims, 5 Drawing Sheets

Fig.1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21e
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22b
B
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P4
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17
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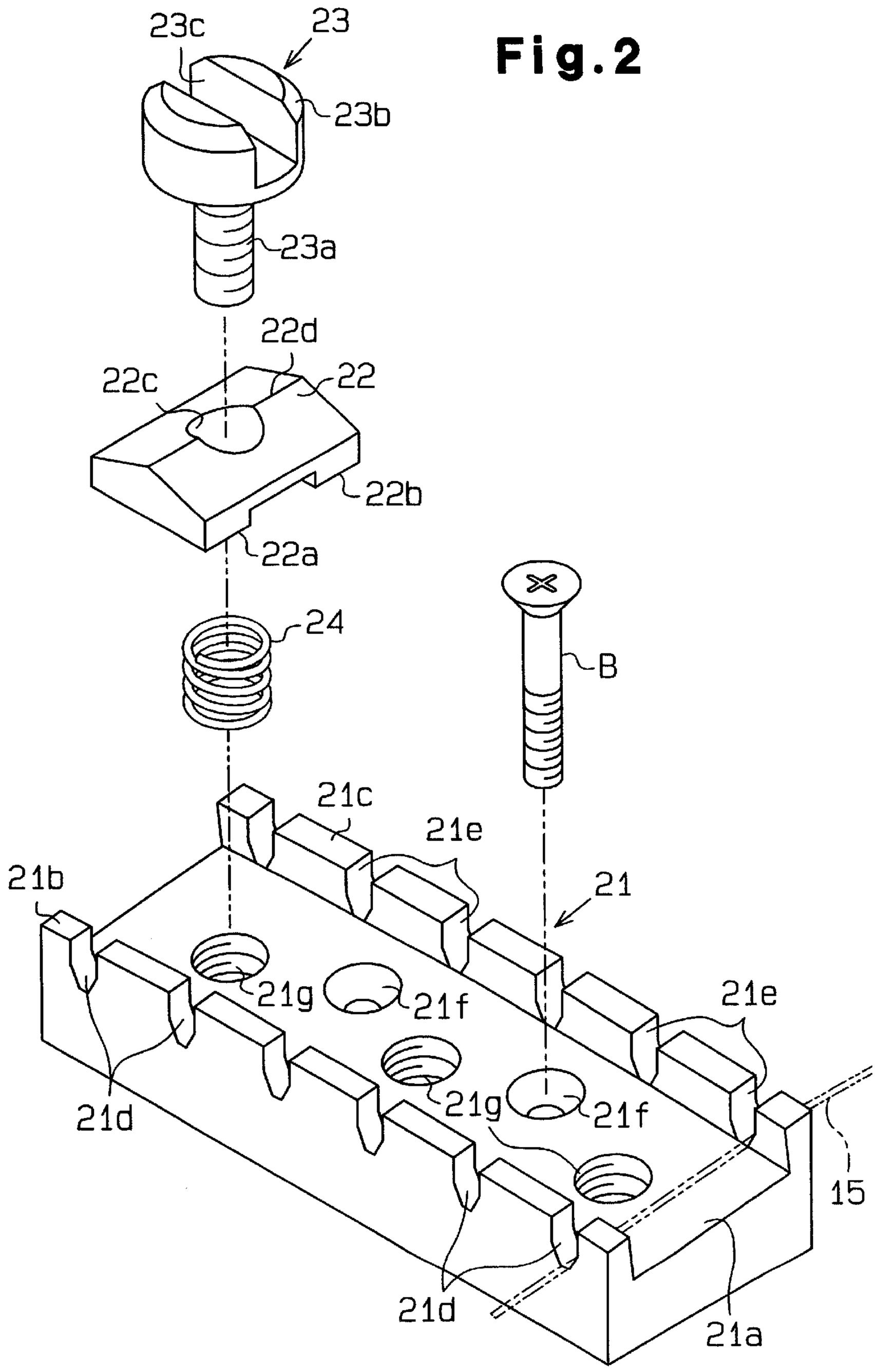
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21d
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Fig.2

Fig.3

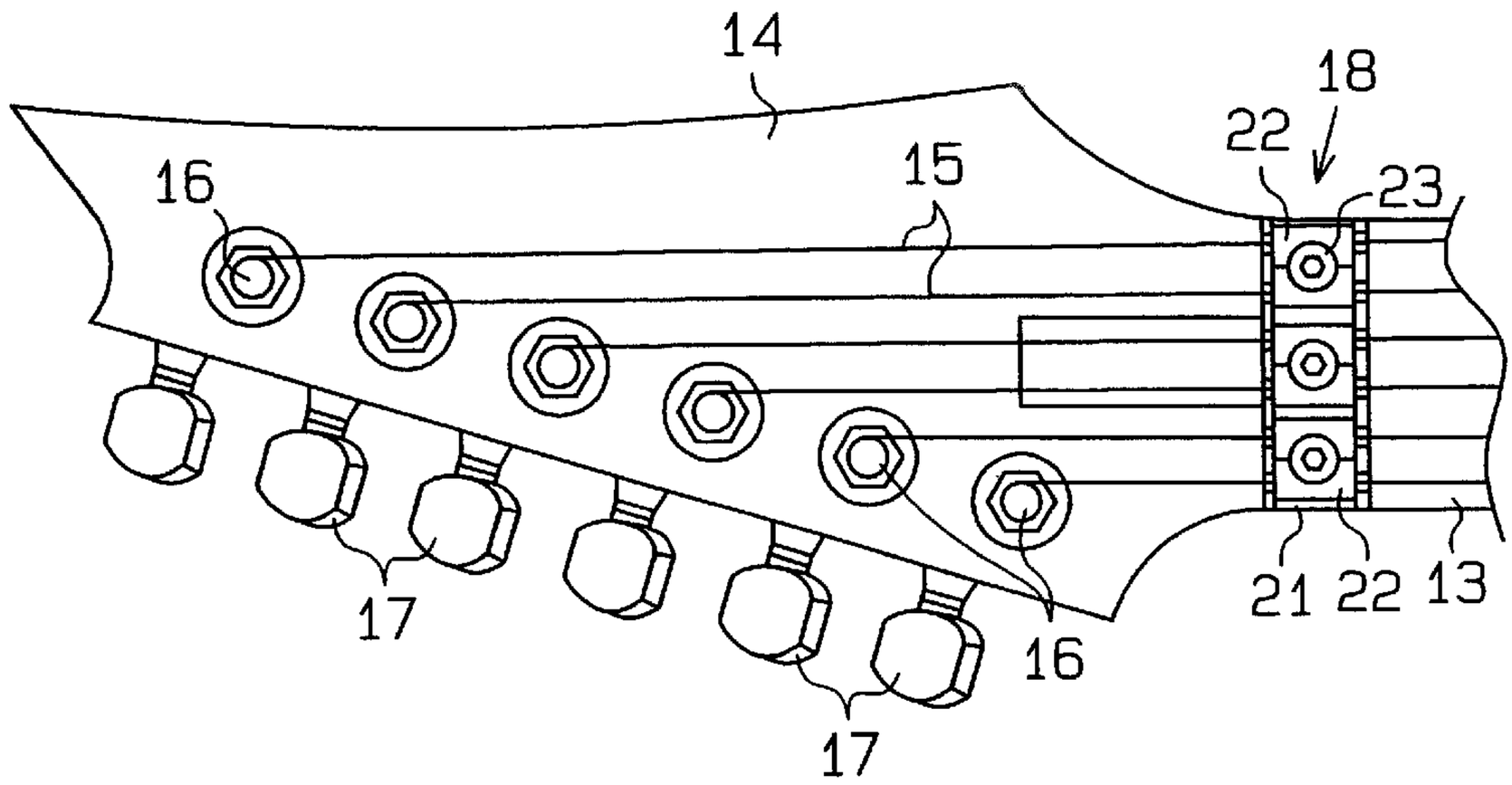


Fig.4

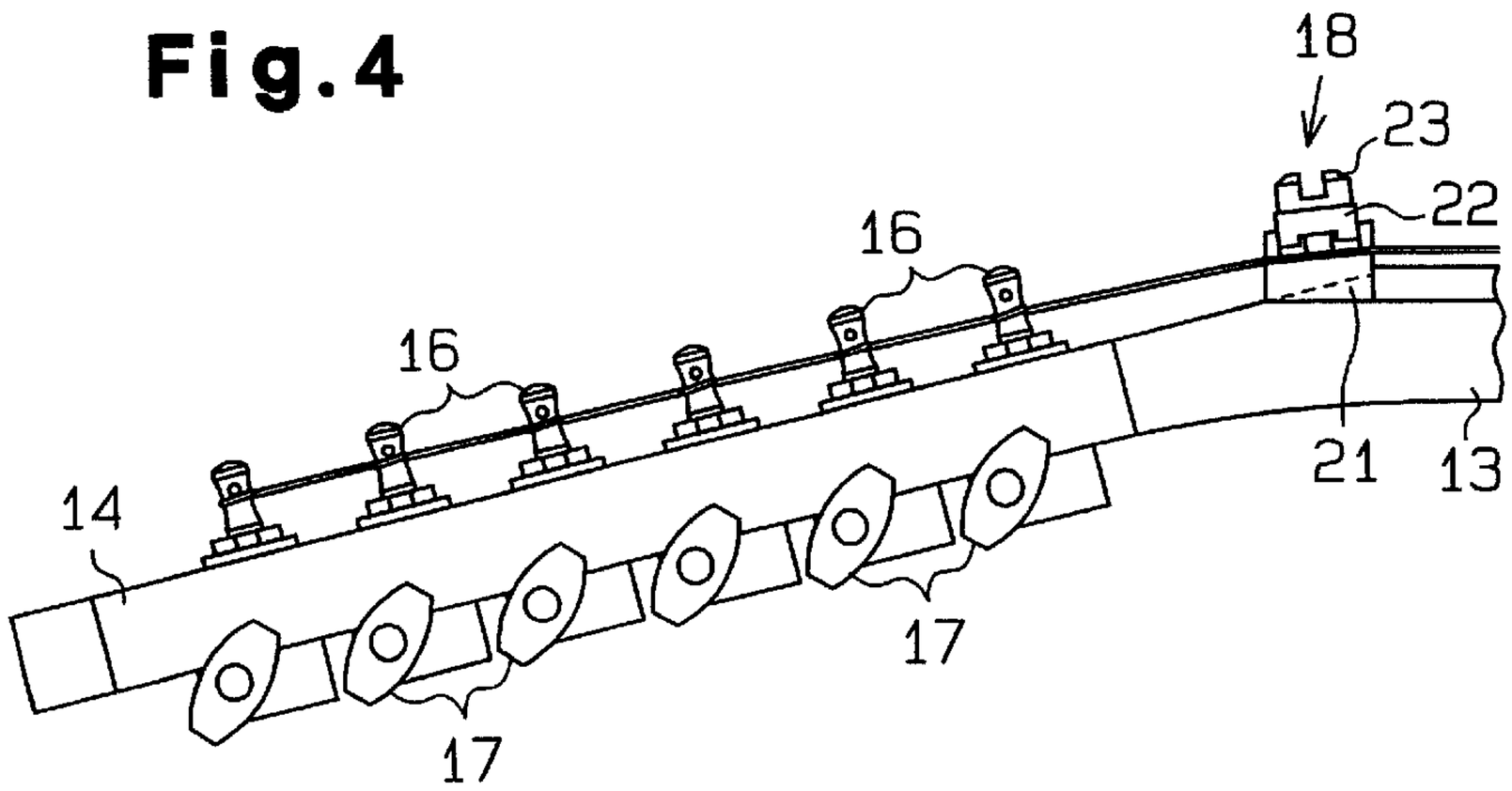


Fig.5

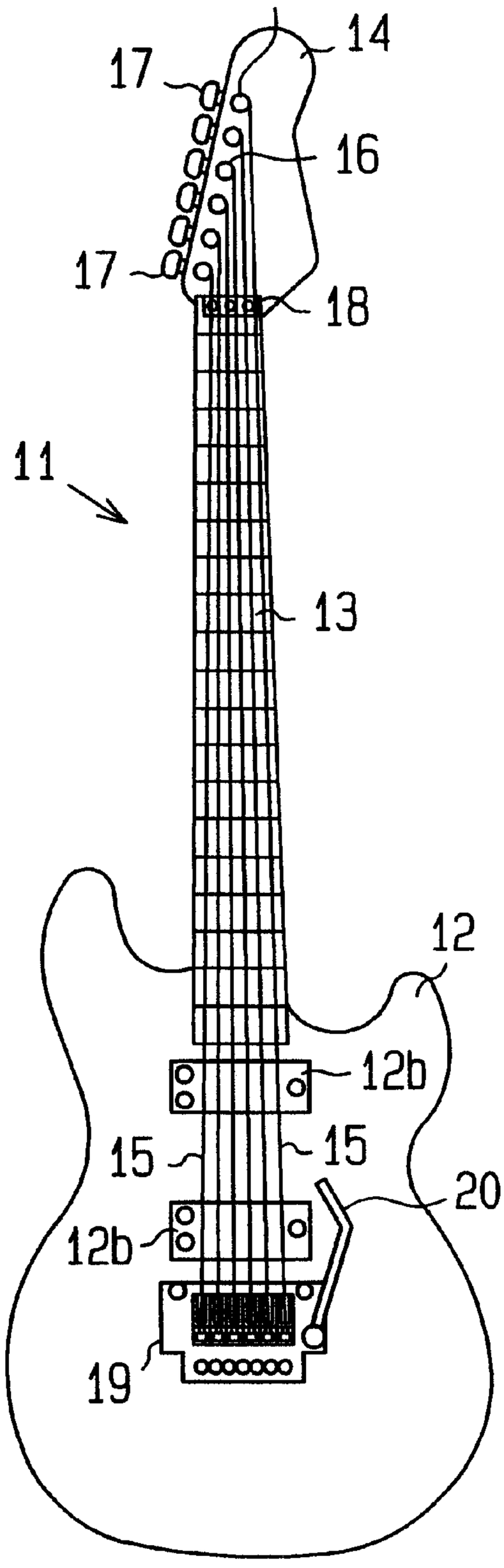


Fig.6 (Prior Art)

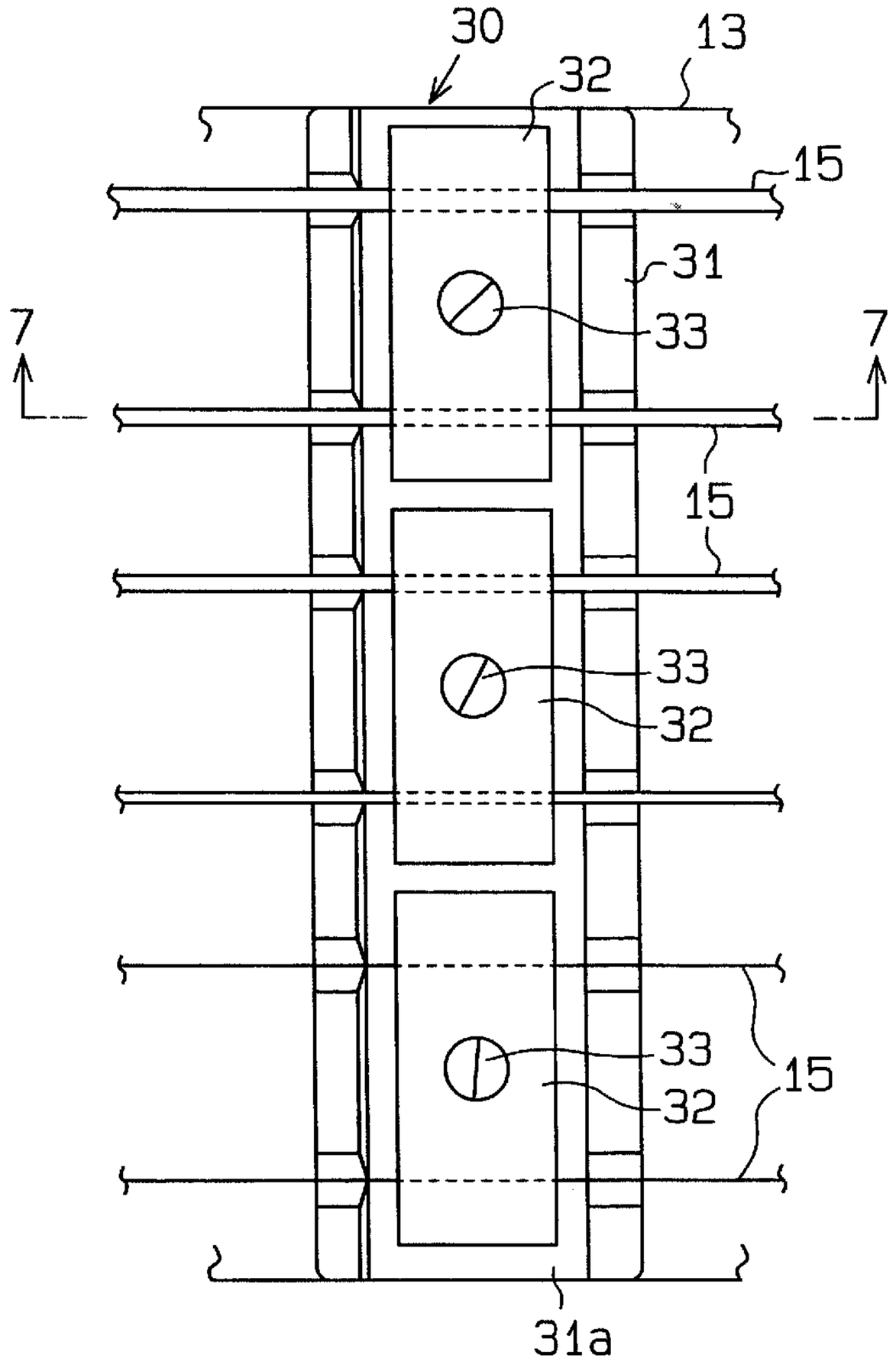
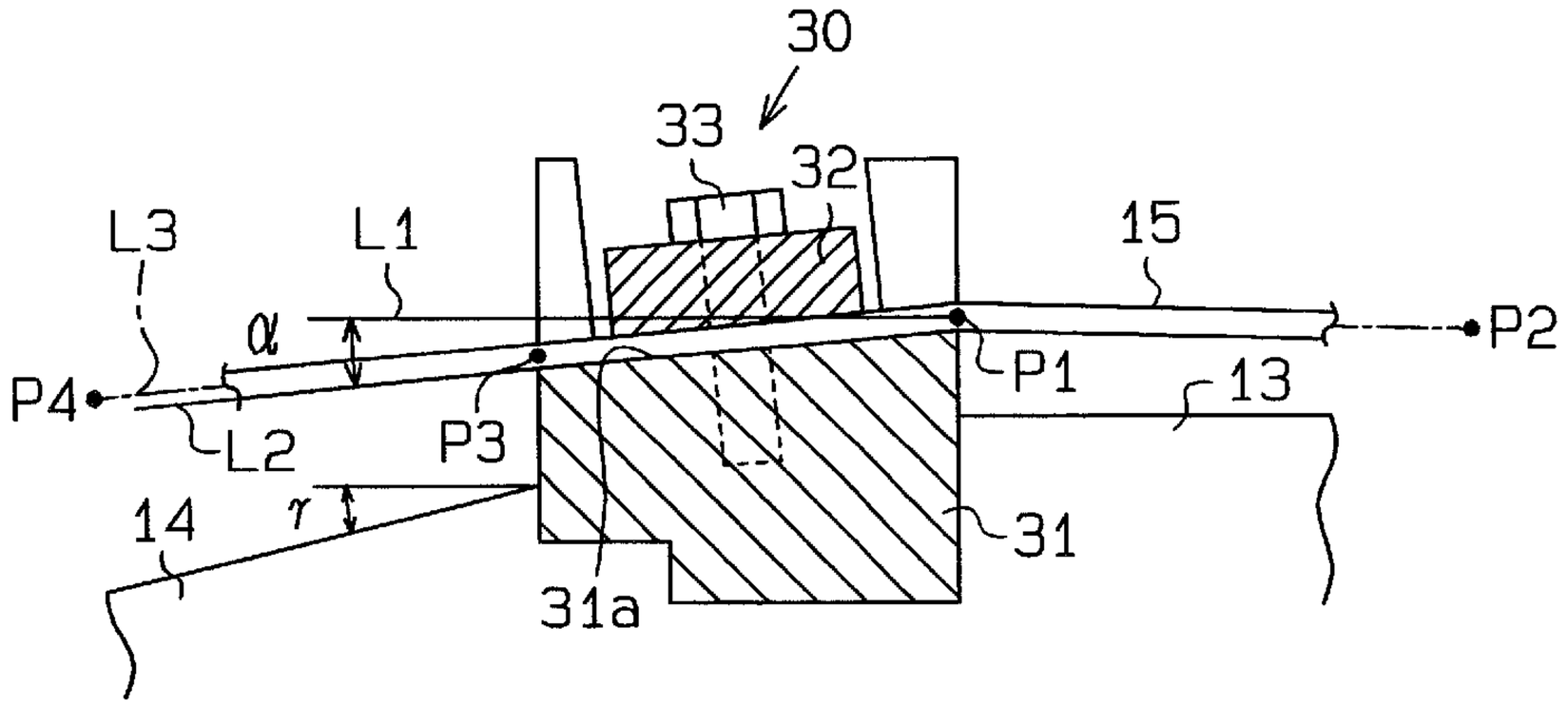


Fig.7 (Prior Art)



ELECTRIC GUITAR WITH TREMOLO UNIT

BACKGROUND OF THE INVENTION

The present invention relates to electric guitars with tremolo units, and, more particularly, to lock devices that are attached to electric guitars to prevent strings from being shifted to offset positions.

In an electric guitar with a tremolo unit, tensions of all strings are adjusted at the same time by the tremolo unit for generating an impressive sound effect. The U.S. Pat. Publication No. 4,171,661 describes a conventional electric guitar, which maintains tuning of the guitar in a stable state even when a tremolo sound effect is used. More specifically, a tremolo unit of the electric guitar includes a saddle that locks proximal ends of strings. Further, with reference to FIG. **6**, a lock device **30**, which is fixed near the head of the guitar, locks distal portions of the strings **15**. As locked by the lock device **30**, the strings **15** cannot be tuned by pegs. Thus, to enable the strings **15** to be finely tuned even in this state, the guitar is provided with a fine tuning device, which is located at the saddle of the tremolo unit.

With reference to FIGS. **6** and **7**, the lock device **30** includes a nut **31**, which is fixed to an upper side of a neck **13** of the guitar, and clamp pads **32**. The nut **31** supports the clamp pads **32**. The clamp pads **32** are pressed against an upper side (a support surface **31***a*) of the nut **31** by fastening bolts **33**, such that the strings **15** are clamped between the clamp pads **32** and the support surface **31***a*. The support surface **31***a* of the nut **31** is inclined with respect to a hypothetical line L**1**, which extends along an edge of the nut **31** close to the proximal ends of the strings **15** (a contact point P**1**) and the proximal ends of the strings **15** (a contact point P**2** between the tremolo unit and the strings **15**), at angle α. The angle α is, for example, five degrees. A hypothetical line L**2**, which extends along the contact point P**1** and a front edge of the nut **31** (a contact point P**3**), is parallel with a hypothetical line L**3**, which extends along a contact point P**4** between the strings **15** and pegs (not illustrated) and the contact point P**1**. The head **14** is bent with respect to the neck **13** at angle γ. The angle γ is, for example, 10 degrees.

In the lock device **30**, the support surface **31***a* of the nut **31** is parallel with the line L**3**. The strings **15** are thus easily separated from the support surface **31***a*. In this case, tuning of the strings **15** becomes unstable. Also, the strings **15** are easily shifted to offset positions. Accordingly, to avoid these problems, the clamp pads **32** need be firmly pressed against the nut **31** by the fastening bolts **33** such that the strings **15** are reliably held by the support surface **31***a*. However, this may damage the strings **15** and decrease the durability of the fastening bolts **33** or damage the bolts **33**.

Further, to solve the problems, the electric guitar may include a retainer bar, which is located between the lock device **30** and the pegs for pressing the strings **15** against an upper side of the head **14**. However, in this case, when installing the strings **15**, the fastening bolts **33** and the clamp pads **32** must be removed from the nut **31**. The strings **15** are then passed through the space between the retainer bar and the head **14**. This complicates the installation of the strings **15**.

SUMMARY OF THE INVENTION

Accordingly, it is an objective of the present invention to provide an electric guitar with a tremolo unit that maintains tuning of strings in a stable state and prevents the strings from being shifted to offset positions.

It is another objective of the present invention to provide an electric guitar with a tremolo unit and a lock device that makes it easy to install strings.

To achieve the foregoing and other objectives and in accordance with the purpose of the present invention, the invention provides an electric guitar with a tremolo unit that adjusts tensions of strings at the same time. The electric guitar includes a body, a neck, a head, a plurality of pegs, and a lock device. The body fixes proximal ends of the strings. The neck projects from the body and has an upper side that faces the strings. The head is fixed to a distal end of the neck and is bent downward from the upper side of the neck. The pegs are attached to the head. Each of the pegs is connected to a distal end of a different one of the strings. The lock device is fixed to the upper side of the neck for preventing strings from being shifted to offset positions. The lock device includes a nut, a pad, and a bolt. The nut has a support surface that supports the strings, a rear edge close to the body, and a front edge close to the pegs. The nut is located such that the front edge is located upward from a hypothetical line that extends along a contact point between the strings and the pegs and the rear edge. The pad presses at least one of the strings against the support surface. The bolt connects the pad to the nut.

Another perspective of the invention is an electric guitar with a tremolo unit that adjusts tensions of strings at the same time. The electric guitar includes a neck, a plurality of pegs, and a nut. The neck has an upper side that faces the strings. Each of the pegs is connected to a distal end of a different one of the strings. The nut is attached to the upper side of the neck. The nut supports the strings such that the strings are substantially parallel with one another. The nut has a front edge close to the distal ends of the strings, a rear edge close to proximal ends of the strings, and a support surface formed between the front edge and the rear edge. The support surface is inclined with respect to the upper side of the neck at a predetermined angle. The predetermined angle is smaller than an angle of portions of the strings between the pegs and the front edge with respect to the upper side of the neck.

Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with objectives and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. **1** is an enlarged view showing a lock device for strings according to an embodiment of the present invention;

FIG. **2** is an exploded perspective view showing the lock device of FIG. **1**;

FIG. **3** is a plan view showing a head of an electric guitar according to the embodiment of the present invention;

FIG. **4** is a side view showing the head of the electric guitar;

FIG. **5** is a plan view showing the electric guitar according to the embodiment of the present invention;

FIG. **6** is a plan view showing a prior art lock device of an electric guitar; and

FIG. **7** is a cross-sectional view taken along line **7**—**7** of FIG. **6**.

DETAILED DESCRIPTION OF THE PREFERED EMBODIMENTS

An electric guitar **11** of an embodiment of the present invention will now be described with reference to FIGS. **1** to **5**.

FIG. **5** is a plan view showing the electric guitar **11**. In the following description, a side of the electric guitar **11** close to a viewer of the drawing is defined as an upper side of the electric guitar **11**.

The electric guitar **11** includes six strings **15**, a solid type body **12**, a neck **13**, and a head **14**. Proximal ends of the strings **15** are fixed to the body **12**. The neck **13** projects from the body **12**, while the head **14** is attached to a distal end of the neck **13**. The head **14** includes six pegs **16** and six knobs **17**. Each of the strings **15** is associated with a different one of the pegs **16**, and the distal end of each string **15** is wound around the associated peg **16**. Likewise, each of the knobs **17** is associated with a different one of the pegs **16**. A gear mechanism (not illustrated) connects each knob **17** to the associated peg **16**. In FIG. **1**, only the peg **16** closest to the neck **13** is illustrated. The knobs **17** are manipulated to rotate the associated pegs **16**. This adjusts tensions of the strings **15** such that the pitches of the strings **15** are tuned. A lock device **18**, which is attached to an upper side of the neck **13**, locks the strings **15** without affecting the tensions of the strings **15**.

A tremolo unit **19** is attached to the body **12**. Between the tremolo unit **19** and the lock device **18**, the strings **15** are held substantially parallel with the upper side of the neck **13** and extend substantially parallel with one another. Pickups **12***b*, each of which converts vibration of an associated one of the strings **15** to an electric signal, are attached to the body **12**. The electric signal is sent to an amplifier by a cable (not illustrated) and is amplified and converted to a sound by the amplifier.

The tremolo unit **19** includes a tremolo arm **20**. The tremolo arm **20** is manipulated to adjust tensions of all strings **15** at the same time. This generates an impressive sound effect.

The lock device **18** will hereafter be described.

With reference to FIG. **1**, a plurality of bolts B secures a nut **21** to the upper side of the neck **13**. The nut **21**, as shown in FIG. **2**, includes a distal guide wall **21***b*, a proximal guide wall **21***c*, and a support surface **21***a*. The distal guide wall **21***b* and the proximal guide wall **21***c* respectively include guide grooves **21***d* and guide grooves **21***e*, which guide the strings **15**. The support surface **21***a* is formed between the guide walls **21***b*, **21***c* for supporting the strings **15**. Securing holes **21***f*, which are formed in the support surface **21***a*, receive the bolts B.

Clamp pads **22**, which press the strings **15** against the support surface **21***a* of the nut **21**, are fixed to the nut **21** by clamp bolts **23**. The clamp bolts **23** each include a threaded shaft **23***a*, which is engaged with a through hole **22***c* formed in each of the clamp pads **22**. A pair of pressing projections **22***a*, **22***b* projects from a lower side of each clamp pad **22** to face the support surface **21***a* of the nut **21**. The strings **15** are clamped between the pressing projections **22***a*, **22***b* and the support surface **21***a* of the nut **21**. Each clamp pad **22** has two upper side sections that are uniformly slanted in opposite directions with respect to a ridge **22***d*. The clamp pads **22** are fixed to the nut **21** such that the ridges **22***d* are substantially parallel with the strings **15**. A groove **23***c* is formed in a head **23***b* of each clamp bolt **23**. The clamp bolt **23** is thus easily rotated by a coin, for example, which is engaged with the groove **23***c*.

A coil spring **24** is located between the nut **21** and each clamp pad **22** and serves as an elastic member for urging the clamp pad **22** upward.

In the following description, with reference to FIG. **1**, a rear edge of the nut **21** close to the body **12** is defined as a

first contact point P**1**, a bridge saddle of the tremolo unit **19** is defined as a second contact point P**2**, and a front edge of the nut **21** close to the peg **19** is defined as a third contact point P**3**. A contact point between the peg **16** and the string **15** is defined as an engaging point P**4**. A line that extends along the first contact point P**1** and the second contact point P**2** is indicated by L**1**. A line that extends along the first contact point P**1** and the third contact point P**3** is indicated by L**2**. A line that extends along the first contact point P**1** and the engaging point P**4** is indicated by L**3**. The inclination angle of the line L**2** with respect to the line L**1** is indicated by α, and the inclination angle of the line L**3** with respect to the line L**2** is indicated by β. The bending angle of the head **14** with respect to the neck **13** (the line L**1**) is indicated by γ.

It is preferred that the inclination angle α be 2.0–12.5 degrees. In this embodiment, the inclination angle α is 4.2 degrees. Likewise, it is preferred that the inclination angle β be 2.0–12.5 degrees. In this embodiment, the inclination angle β is 5.0 degrees. The bending angle γ is generally 10.0–18.0 degrees and, in this embodiment, is 14.0 degrees. The interval between the third contact point P**3** and the line L**3** is changed in relation to the angles α, β, γ. For example, the third contact point P**3** is spaced from the line L**3** by, for example, 0.5 to 3.5 millimeters.

If the bending angle γ is 14.0 degrees, it is preferred that the inclination angle α be 3.0–7.0 degrees and the inclination angle β be 3.0–7.0 degrees. In this embodiment, the pegs **16** at the standard height of 9.5 millimeters are used. Further, the interval between the contact points P**1**, P**3** is 15.5 millimeters, while the interval between the contact point P**3** and the engaging point P**4** is 36.5 millimeters. In addition, a minimum value of the inclination angle α and a minimum value of the inclination angle β are both set at 3.0 degrees such that the friction resistance between the strings **15** and the nut **21** exceeds a required minimum level. However, if the pegs **16** at the standard height of 3.7 millimeters, which are relatively short, are used, a maximum value of the inclination angle α and a maximum value of the inclination angle γ are both set at 7.0 degrees such that the friction resistance between the strings **15** and the nut **21** exceeds the required minimum level. For example, if the inclination angles α, β are both 3.0 degrees, the string **15** is spaced from the line L**3** at the contact point P**3** by 0.8 millimeters. Likewise, if the inclination angles α, β are both 7.0 degrees, the string **15** is spaced from the line L**3** at the contact point P**3** by 1.5 millimeters.

The operation of the lock device **18** will hereafter be described.

When installing the strings **15**, the clamp bolts **23** are loosened to separate the clamp pads **22** from the support surface **21***a* of the nut **21** at a predetermined interval. In this state, one end of each string **15** is fixed to the bridge saddle of the tremolo unit **19**, while the other is passed through an associated one of the guide grooves **21***e*. This end is then passed through the space between the support surface **21***a* of the nut **21** and the lower side of the associated clamp pad **22** and the guide groove **21***d*. The end of the string **15** is thus engaged with the associated peg **16**. Subsequently, while maintaining the clamp pads **22** as separated from the support surface **21***a*, the knobs **17** are manipulated to rotate the pegs **16** such that a predetermined tension is applied to each string **15** to tune the pitch of the string **15**. In this state, the strings **15** contact the support surface **21***a* of the nut **21** at the first contact point P**1** and the third contact point P**3** in a bent manner. The strings **15** are fixed to the nut **21** by fastening the clamp pads **22** to the support surface **21***a* of the nut **21** by the clamp bolts **23**.

The advantages of the lock device **18** are as follows.

(1) In the illustrated embodiment, the inclination angle β is 2.0–12.5 degrees and the third contact point P**3** is spaced upward from the line L**3** by 0.5–3.5 millimeters. The strings **15** are thus bent by the nut **21** at the first and third contact points P**1**, P**3**. This firmly holds the strings **15** in a state supported by the support surface **21***a* of the nut **21**, without using a retainer. The friction resistance between the nut **21** and the strings **15** is thus increased. This maintains tuning of the strings **15** in a stable state and prevents the strings **15** from being shifted to offset positions.

Further, the clamp pads **22** press the strings **15** against the support surface **21***a* of the nut **21**. Thus, without using a retainer, the tuning of the strings **15** is maintained in the stable state while the strings **15** are prevented from being shifted to offset positions. Also, the clamp pads **22** prevent the strings **15** from being longitudinally shifted to offset positions when the strings **15** are being locked. In addition, since it is unnecessary to fasten the clamp pads **22** by excessive force, the strings **15** are prevented from being damaged.

(2) In the illustrated embodiment, the support surface **21***a* of the nut **21** is flat. It is thus easy to fabricate the nut **21** such that the third contact point P**3** is located upward from the line L**3**.

(3) In the illustrated embodiment, the clamp pads **22** each include two pressing projections **22***a*, **22***b*. The projections **22***a*, **22***b* press the strings **15** against the support surface **21***a* of the nut **21** at two positions. This enables the clamp pads **22** to reliably clamp the strings **15** near the first contact point P**1** and the third contact position P**3**. The strings **15** thus reliably contact the nut **21** at the first and third contact points P**1**, P**3**.

(4) In the illustrated embodiment, the coil springs **24** are located between the support surface **21***a* of the nut **21** and the clamp pads **22**. When the clamp bolts **23** are fastened, the coil springs **24** urge the clamp pads **22** upward from the support surface **21***a* of the nut **21**. Thus, without removing the clamp pads **22**, the strings **15** can be installed and tuned. If the coil springs **24** are not provided, the clamp pads **22** contact the strings **15** when the clamp bolts **23** are loosened. This hampers accurate tuning of the strings **15**.

Further, tuning of the strings **15** can be maintained in a stable state when the strings **15** are being locked. In addition, the strings **15** are prevented from being shifted to offset positions when the clamp pads **22** are being fastened.

The support surface **21***a* of the nut **21** is inclined with respect to the upper side of the neck **13**. The angle between the support surface **21***a* and the upper side of the neck **13** is smaller than the angle of portions of the strings **15** between the pegs **16** and the front edge of the nut **21**, which corresponds to the first contact point P**3**, with respect to the upper side of the neck **13**. Accordingly, the strings **15** are bent by the nut **21** at two positions (the first and third contact positions P**1**, P**3**). The strings **15** are thus prevented from being separated from the support surface **21***a* of the nut **21**.

The illustrated embodiment may be modified as follows.

The height of the pegs **16**, or the projecting amount of the pegs **16** from the upper side of the head **14**, may be substantially minimized. In this case, the bending angle of the strings **15** at the third contact point P**3** is increased. The strings **15** thus contact the nut **21** by an accordingly increased friction force.

The present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

What is claimed is:

1. An electric guitar **(11)** with a tremolo unit that adjusts tensions of strings at the same time, comprising:

a body, wherein the body fixes proximal ends of the strings;

a neck, which projects from the body, wherein the neck has an upper side that faces the strings;

a head, which is fixed to a distal end of the neck, wherein the head is bent downward from the upper side of the neck;

a plurality of pegs attached to the head, wherein each of the pegs is connected to a distal end of a different one of the strings; and

a lock device fixed to the upper side of the neck for preventing the strings from being shifted to offset positions, wherein the lock device includes:

a nut, wherein the nut has a support surface that supports the strings, a rear edge close to the body, and a front edge close to the pegs, and the nut is located such that the front edge is located upward from a hypothetical line, which extends along a contact point between the strings and the pegs and the rear edge so that the strings form a first angle of inclination between the hypothetical line and a first line which extends along a contact point between the strings and the rear edge and between the strings and the front edge at the front edge of the nut and a second angle of inclination between the first line and a second line which extends along a contact point between the strings and the rear edge and between the strings and the tremolo unit at the rear edge of the nut, the first angle of inclination and the second angle of inclination being substantially equal;

a pad, wherein the pad presses at least one of the strings against the support surface; and

a bolt, wherein the bolt connects the pad to the nut.

2. The electric guitar according to claim **1**, wherein the support surface is a flat surface inclined with respect to the upper side of the neck.

3. The electric guitar according to claim **2**, wherein:

a bending angle between the upper side of the neck and the head is in the range of from 10.0 to 18.0 degrees;

the support surface is inclined with respect to a hypothetical line that extends along a contact point between the tremolo unit and the strings and the rear edge of the nut at an angle of 2.0 to 12.5 degrees; and

the support surface is inclined with respect to a hypothetical line that extends along a contact point between the strings and the pegs and the rear edge of the nut at an angle of 2.0 to 12.5 degrees.

4. The electric guitar according to claim **2**, wherein:

a bending angle between the upper side of the neck and the head is 14.0 degrees;

the support surface is inclined with respect to a hypothetical line that extends along a contact point between the tremolo unit and the strings and the rear edge of the nut at an angle of 3.0 to 7.0 degrees; and

the support surface is inclined with respect to a hypothetical line that extends along a contact point between the strings and the pegs and the rear edge of the nut at an angle of 3.0 to 7.0 degrees.

5. The electric guitar according to claim **1**, wherein the pad includes at least two pressing projections that press at least one of the strings.

6. The electric guitar according to claim 1, wherein the lock device further includes an elastic member located between the support surface and the pad for urging the pad away from the support surface.

7. An electric guitar with a tremolo unit that adjusts tensions of strings at the same time, comprising:

a neck, wherein the neck has an upper side that faces the strings;

a plurality of pegs, wherein each of the pegs is connected to a distal end of a different one of the strings; and

a nut, which is attached to the upper side of the neck, wherein the nut supports the strings such that the strings are substantially parallel with one another, the nut has a front edge close to the distal ends of the strings, a rear edge close to proximal ends of the strings, and a support surface formed between the front edge and the rear edge, the support surface is inclined with respect to the upper side of the neck at a predetermined angle, and the predetermined angle is smaller than an angle of portions of the strings between the pegs and the front edge with respect to the upper side of the neck so that the strings form angles at the front edge and at the rear edge that are substantially equal.

8. The electric guitar according to claim 7, further comprising:

a pad, wherein the pad presses at least one of the strings against the nut; and

a bolt, wherein the bolt connects the pad to the nut.

9. The electric guitar according to claim 8, further comprising two pressing projections, which project from the pad, wherein the pressing projections cooperate with the nut to clamp the at least one of the strings.

10. The electric guitar according to claim 8, further comprising an elastic member, which is located between the nut and the pad in a compressed state.

11. An electric guitar with a tremolo unit, comprising:

a nut, which is attached to an upper side of a neck, wherein the nut supports strings such that the strings are substantially parallel with one another, the nut has a front edge close to distal ends of the strings and a rear edge close to proximal ends of the strings, and the strings are bent by the nut at the front edge and the rear edge so that the strings form an angle at the front edge substantially equal to an angle of the strings at the rear edge;

a pad, wherein the pad presses at least one of the strings against the nut; and

a bolt, wherein the bolt connects the pad to the nut; and

an elastic member, which is held between the nut and the pad in a compressed state.

* * * * *